Fig. 205 illustrates the process of print head pulse characterization;

Fig. 206 is an exploded perspective, in section, of the print head ink supply mechanism;

~~Fig. 207 is a bottom perspective of the ink head supply unit;~~

Fig. 208 is a bottom side sectional view of the ink head supply unit;

Fig. 209 is a top perspective of the ink head supply unit;

Fig. 210 is a top side sectional view of the ink head supply unit;

Fig. 211 illustrates a perspective view of a small portion of the print head;

Fig. 212 illustrates is an exploded perspective of the print head unit;

Fig. 213 illustrates a top side perspective view of the internal portions of an Artcam camera, showing the parts flattened out;

Fig. 214 illustrates a bottom side perspective view of the internal portions of an Artcam camera, showing the parts flattened out;

Fig. 215 illustrates a first top side perspective view of the internal portions of an Artcam camera, showing the parts as encased in an Artcam;

Fig. 216 illustrates a second top side perspective view of the internal portions of an Artcam camera, showing the parts as encased in an Artcam;

Fig. 217 illustrates a second top side perspective view of the internal portions of an Artcam camera, showing the parts as encased in an Artcam;

Fig. 218 illustrates the backing portion of a postcard print roll;

Fig. 219 illustrates the corresponding front image on the postcard print roll after printing out images;

Fig. 220 illustrates a form of print roll ready for purchase by a consumer;

Fig. 221 illustrates a layout of the software/hardware modules of the overall Artcam application;

Fig. 222 illustrates a layout of the software/hardware modules of the Camera Manager;

Fig. 223 illustrates a layout of the software/hardware modules of the Image Processing Manager;

Fig. 224 illustrates a layout of the software/hardware modules of the Printer Manager;

Fig. 225 illustrates a layout of the software/hardware modules of the Image Processing Manager;

Fig. 226 illustrates a layout of the software/hardware modules of the File Manager;

Fig. 227 illustrates a perspective view, partly in section, of an alternative form of printroll;

Fig. 228 is a left side exploded perspective view of the print roll of Fig. 227;

Fig. 229 is a right side exploded perspective view of a single printroll;

Fig. 230 is an exploded perspective view, partly in section, of the core portion of the printroll; and

Fig. 231 is a second exploded perspective view of the core portion of the printroll.

DESCRIPTION OF PREFERRED AND OTHER EMBODIMENTS

The digital image processing camera system constructed in accordance with the preferred embodiment is as illustrated in Fig. 1. The camera unit 1 includes means for the insertion of an integral print roll (not shown). The camera unit 1 can include an area image sensor 2 which sensors an image 3 for captured by the camera. Optionally, the second area image sensor can be provided to also image the scene 3 and to optionally provide for the production of stereographic output

Additionally, the print roll interface chip can provide valuable authentication information and can be constructed in a tamper proof manner. Further, a tamper resistant method of utilising the chip has been provided. The utilization of the print roll chip also allows a convenient and effective user interface to be provided for an immediate output form of Artcam device able to output multiple photographic formats whilst simultaneously able to provide an indicator of the number of photographs left in the printing device.

Print Head Unit

Turning now to Fig. 206 , there is illustrated an exploded perspective view, partly in section, of the print head unit 615 of Fig. 162.

The print head unit 615 is based around the print-head 44 which ejects ink drops on demand on to print media 611 so as to form an image. The print media 611 is pinched between two set of rollers comprising a first set 618, 616 and second set 617, 619.

The print-head 44 operates under the control of power, ground and signal lines 810 which provides power and control for the print-head 44 and are bonded by means of Tape Automated Bonding (TAB) to the surface of the print-head 44.

Importantly, the print-head 44 which can be constructed from a silicon wafer device suitably separated, relies upon a series of anisotropic etches 812 through the wafer having near vertical side walls. The through wafer etches 812 allow for the direct supply of ink to the print-head surface from the back of the wafer for subsequent ejection.

The ink is supplied to the back of the inkjet print-head 44 by means of ink-head supply unit 814. The inkjet print-head 44 has three separate rows along its surface for the supply of separate colors of ink. The ink-head supply unit 814 also includes a lid 815 for the sealing of ink channels.

In ~~Fig. 207 to~~ Fig. 210, there is illustrated various perspective views of the ink-head supply unit 814. ~~Each of Fig. 207 to~~ Fig. 210 illustrate only a portion of the ink head supply unit which can be constructed of indefinite length, the portions shown so as to provide exemplary details. In ~~Fig. 207 there is illustrated a bottom perspective view~~, Fig. 148 illustrates a top perspective view, Fig. 209 illustrates a close up bottom perspective view, partly in section, Fig. 210 illustrates a top side perspective view showing details of the ink channels, and Fig. 211 illustrates a top side perspective view as does Fig. 212.

There is considerable cost advantage in forming ink-head supply unit 814 from injection molded plastic instead of, say, micromachined silicon. The manufacturing cost of a plastic ink channel will be considerably less in volume and manufacturing is substantially easier. The design illustrated in the accompanying Figures assumes a 1600 dpi three color monolithic print head, of a predetermined length. The provided flow rate calculations are for a 100mm photo printer.

The ink-head supply unit 814 contains all of the required fine details. The lid 815 (Fig. 206) is permanently glued or ultrasonically welded to the ink-head supply unit 814 and provides a seal for the ink channels.

Turning to Fig. 209, the cyan, magenta and yellow ink flows in through ink inlets 820-822, the magenta ink flows through the throughholes 824,825 and along the magenta main channels 826,827 (Fig. 141). The cyan ink flows along cyan main channel 830 and the yellow ink flows along the yellow main channel 831. As best seen from Fig. 209, the cyan ink in the cyan main channels then flows into a cyan sub-channel 833. The yellow subchannel 834 similarly receiving yellow ink from the yellow main channel 831.

As best seen in Fig. 210, the magenta ink also flows from magenta main channels 826,827 through magenta

throughholes 836, 837. Returning again to Fig. 209, the magenta ink flows out of the throughholes 836, 837. The magenta ink flows along first magenta subchannel e.g. 838 and then along second magenta subchannel e.g. 839 before flowing into a magenta trough 840. The magenta ink then flows through magenta vias e.g. 842 which are aligned with corresponding inkjet head throughholes (e.g. 812 of Fig. 166) wherein they subsequently supply ink to inkjet nozzles for printing out.

Similarly, the cyan ink within the cyan subchannel 833 flows into a cyan pit area 849 which supplies ink two cyan vias 843, 844. Similarly, the yellow subchannel 834 supplies yellow pit area 46 which in turn supplies yellow vias 847, 848.

As seen in Fig. 210, the print-head is designed to be received within print-head slot 850 with the various vias e.g. 851 aligned with corresponding through holes eg. 851 in the print-head wafer.

Returning to Fig. 206, care must be taken to provide adequate ink flow to the entire print-head chip 44, while satisfying the constraints of an injection moulding process. The size of the ink through wafer holes 812 at the back of the print head chip is approximately 100μm x 50μm, and the spacing between through holes carrying different colors of ink is approximately 170μm. While features of this size can readily be molded in plastic (compact discs have micron sized features), ideally the wall height must not exceed a few times the wall thickness so as to maintain adequate stiffness. The preferred embodiment overcomes these problems by using hierarchy of progressively smaller ink channels.

In Fig. 211, there is illustrated a small portion 870 of the surface of the print-head 44. The surface is divided into 3 series of nozzles comprising the cyan series 871, the magenta series 872 and the yellow series 873. Each series of nozzles is further divided into two rows eg. 875, 876 with the print-head 44 having a series of bond pads 878 for bonding of power and control signals.

The print head is preferably constructed in accordance with a large number of different forms of ink jet invented for uses including Artcam devices. These ink jet devices are discussed in further detail hereinafter.

The print-head nozzles include the ink supply channels 880, equivalent to anisotropic etch hole 812 of Fig. 206. The ink flows from the back of the wafer through supply channel 881 and in turn through the filter grill 882 to ink nozzle chambers eg. 883. The operation of the nozzle chamber 883 and print-head 44 (Fig. 1) is, as mentioned previously, described in the abovementioned patent specification.

Ink Channel Fluid Flow Analysis

Turning now to an analysis of the ink flow, the main ink channels 826, 827, 830, 831 ~~(Fig. 207~~, Fig. 141) are around 1mm x 1mm, and supply all of the nozzles of one color. The sub-channels 833, 834, 838, 839 (Fig. 209) are around 200μm x 100μm and supply about 25 inkjet nozzles each. The print head through holes 843, 844, 847, 848 and wafer through holes eg. 881 (Fig. 211) are 100μm x 50μm and, supply 3 nozzles at each side of the print head through holes. Each nozzle filter 882 has 8 slits, each with an area of 20μm x 2μm and supplies a single nozzle.

An analysis has been conducted of the pressure requirements of an ink jet printer constructed as described. The analysis is for a 1,600 dpi three color process print head for photograph printing. The print width was 100 mm which gives 6,250 nozzles for each color, giving a total of 18,750 nozzles.

The maximum ink flow rate required in various channels for full black printing is important. It determines the pressure drop along the ink channels, and therefore whether the print head will stay filled by the surface tension forces alone, or, if not, the ink pressure that is required to keep the print head full.

To calculate the pressure drop, a drop volume of 2.5 pl for 1,600 dpi operation was utilized. While the nozzles may be capable of operating at a higher rate, the chosen drop repetition rate is 5 kHz which is suitable to print a 150 mm long

The ink head supply unit 14 (Fig. 1) has features as small as 50μ and a length of 106mm. It is impractical to machine the injection moulding tools in the conventional manner. However, even though the overall shape may be complex, there are no complex curves required. The injection moulding tools can be made using conventional milling for the main ink channels and other millimeter scale features, with a lithographically fabricated inset for the fine features. A LIGA process can be used for the inset.

A single injection moulding tool could readily have 50 or more cavities. Most of the tool complexity is in the inset.

Turning to Fig. 206, the printing system is constructed via moulding ink supply unit 814 and lid 815 together and sealing them together as previously described. Subsequently print-head 44 is placed in its corresponding slot 850. Adhesive sealing strips 852, 853 are placed over the magenta main channels so to ensure they are properly sealed. The Tape Automated Bonding (TAB) strip 810 is then connected to the inkjet print-head 44 with the tab bonding wires running in the cavity 855. As can best be seen from Fig. 206, ~~Fig. 207~~ and Fig. 212, aperture slots 855 - 862 are provided for the snap in insertion of rollers. The slots provided for the "clipping in" of the rollers with a small degree of play subsequently being provided for simple rotation of the rollers.

In Fig. 213 to Fig. 217, there are illustrated various perspective views of the internal portions of a finally assembled Artcam device with devices appropriately numbered.

- Fig. 213 illustrates a top side perspective view of the internal portions of an Artcam camera, showing the parts flattened out;
- Fig. 214 illustrates a bottom side perspective view of the internal portions of an Artcam camera, showing the parts flattened out;Fig. 215 illustrates a first
- top side perspective view of the internal portions of an Artcam camera, showing the parts as encased in an Artcam;

Fig. 216 illustrates a second top side perspective view of the internal portions of an Artcam camera, showing the parts as encased in an Artcam;

- Fig. 217 illustrates a second top side perspective view of the internal portions of an Artcam camera, showing the parts as encased in an Artcam;

Postcard Print Rolls

Turning now to Fig. 218, in one form of the preferred embodiment, the output printer paper 11 can, on the side that is not to receive the printed image, contain a number of pre-printed "postcard" formatted backing portions 885. The postcard formatted sections 885 can include prepaid postage "stamps" 886 which can comprise a printed authorization from the relevant postage authority within whose jurisdiction the print roll is to be sold or utilised. By agreement with the relevant jurisdictional postal authority, the print rolls can be made available having different postages. This is especially convenient where overseas travelers are in a local jurisdiction and wishing to send a number of postcards to their home country. Further, an address format portion 887 is provided for the writing of address dispatch details in the usual form of a postcard. Finally, a message area 887 is provided for the writing of a personalized information.

Turning now to Fig. 218 and Fig. 219, the operation of the camera device is such that when a series of images 890-892 is printed on a first surface of the print roll, the corresponding backing surface is that illustrated in Fig. 218. Hence, as each image eg. 891 is printed by the camera, the back of the image has a ready made postcard 885 which can be immediately dispatched at the nearest post office box within the jurisdiction. In this way, personalized postcards can be created.

It would be evident that when utilising the postcard system as illustrated in Fig. 219 and Fig. 220 only